United Kingdom of Great Britain and Northern Ireland

EDICT OF GOVERNMENT

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BS NA EN 1990 (2005) (English): UK National Annex for Eurocode. Basis of structural design

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BRITISH NATIONAL ANNEX

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BS EN 1990:
2002+A1:2005
Incorporating National Amendment No. 1

UK National Annex for Eurocode – Basis of structural design

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Highways Agency

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National Annex (informative) to BS EN 1990:2002: Eurocode basis of structural design

Introduction

This National Annex has been prepared by BSI Subcommittee B/525/1, *Actions (loadings) and basis of design*. In the UK, it is to be used in conjunction with BS EN 1990:2002+A1:2005.

This National Annex has been updated to reflect the 2005 amendment to the Eurocode. The start and finish of text introduced or altered by National Amendment No. 1 is indicated in the text by tags A1 A1.

NA.1 Scope

A1 This National Annex gives nationally determined parameters for the following clauses of BS EN 1990:2002+A1:2005.

a) The nationally determined parameters for the clauses below apply to buildings and civil engineering works. (See **NA.2.1**.)

— **A1.1**(1)

b) The nationally determined parameters for the clauses below apply to buildings (See **NA.2.2**.)

— **A1.2.1** (1) NOTE 2
— **A1.2.2** (Table A1.1) NOTE
— **A1.3.1** (1) [Tables A1.2(A) to (C)] NOTE
— **A1.3.1** (5) NOTE
— **A1.3.2** (Table A1.3)
— **A1.4.2** (2) NOTE

c) Nationally determined parameters for the clauses below apply to bridges (see **NA.2.3**).

— **A2.1.1**(1) NOTE 3
— **A2.2.1** (2) NOTE 1
— **A2.2.2** (1), (3), (4), (6)
— **A2.2.3** (2), (3), (4)
— **A2.2.4** (1), (4)
— **A2.2.6** (1) NOTE 1, NOTE 2, NOTE 3
— **A2.3.1** (1), (5), (7), (8)
— **A2.3.2** (1), Table A2.5 NOTE
— **A2.4.1** (1) NOTE 1, Table A2.6 NOTE 2, (2) NOTE
— **A2.4.3.2** (1) NOTE
— **A2.4.4.1** (1) NOTE 3
— **A2.4.4.2.1** (4)P NOTE
— **A2.4.4.2.2** Table A2.7 NOTE
— **A2.4.4.2.2** (3)P NOTE
— **A2.4.4.2.3** (1) NOTE
— **A2.4.4.2.3** (2) NOTE, (3) NOTE
— **A2.4.4.2.4** (2) NOTE, Table A2.8 NOTE 3
— **A2.4.4.2.4** (3) NOTE
— **A2.4.4.3.2** (6) NOTE

NOTE Clauses applicable for cranes and machinery; silos and tanks, etc. will be added by amending the National Annex at appropriate future dates.

d) Guidance on use of the Informative Annexes B, C and D for buildings and civil engineering works. (See **NA.3.1**.)

e) Guidance on use of the Informative Annexes B, C and D for bridges. (See **NA.3.2**.)

f) References to non-contradictory complementary information applicable to buildings and civil engineering works. (See **NA.4.1**.)

g) References to non-contradictory complementary information applicable to bridges. (See **NA.4.2**.) 〈A1〉

NA.2 Nationally determined parameters

NA.2.1 Nationally determined parameters for buildings and civil engineering works

NA.2.1.1 *EN 1990 Clause A.1.1 Field of application*

Table NA.2.1 provides modified values for the design working life given in Table 2.1 of EN 1990.

〈A1〉 NOTE The values of design working life in Table NA.2.1 are indicative. Alternative values of design working life may be determined for the individual project. 〈A1〉

Table NA.2.1 – Indicative design working Life

Design working life category	Indicative design working life (years)	Examples
1	10	Temporary structures[a]
2	10 to 30	Replaceable structural parts, e.g. gantry girders, bearings
3	15 to 25	Agricultural and similar structures
4	50	Building structures and other common structures, not listed elsewhere in this table
5	120	Monumental building structures, highway and railway bridges, and other civil engineering structures

[a] Structures or parts of structures that can be dismantled with a view of being re-used should not be considered as temporary.

NA.2.2 Nationally determined parameters for buildings

NA.2.2.1 *Clause A.1.2.1 (1)*

a) All effects of actions that can exist simultaneously should be considered together in combination of actions.

b) With regard to Note 2 of Clause A.1.2.1 (1) of EN 1990 no modifications are allowed through the National Annex for A1.2.1 (2) and (3).

NA.2.2.2 *Clause A.1.2.2*

Table NA.A1.1 provides values for the symbols of Table A1.1 of EN 1990.

Table NA.A1.1 – Values of Ψ factors for buildings

Action	Ψ_0	Ψ_1	Ψ_2
Imposed loads in buildings, category (see EN 1991-1.1)			
Category A: domestic, residential areas	0,7	0,5	0,3
Category B: office areas	0,7	0,5	0,3
Category C: congregation areas	0,7	0,7	0,6
Category D: shopping areas	0,7	0,7	0,6
Category E: storage areas	1,0	0,9	0,8
Category F: traffic area, vehicle weight $\leq$ 30 kN	0,7	0,7	0,6
Category G: traffic area, 30 kN < vehicle weight $\leq$ 160 kN	0,7	0,5	0,3
Category H: roofs[a]	0,7	0	0
Snow loads on buildings (see EN 1991-3)			
— for sites located at altitude H > 1 000 m a.s.l.	0,70	0,50	0,20
— for sites located at altitude H $\leq$ 1 000 m a.s.l.	0,50	0,20	0
Wind loads on buildings (see EN 1991-1-4)	0,5	0,2	0
Temperature (non-fire) in buildings (see EN 1991-1-5)	0,6	0,5	0

[a] See also EN 1991-1-1: Clause 3.3.2 (1)

NA.2.2.3 *Clause A.1.3*

NA.2.2.3.1 *Values for the symbols γ of Table A1.2 (A)*

Table NA.A1.2 (A) provides the values for the symbols γ of Table A1.2 (A). The values chosen are:

$\gamma_{Gj,sup} = 1,10$

$\gamma_{Gj,inf} = 0,90$

$\gamma_{Q,1} = 1,50$ where unfavourable (0 where favourable)

$\gamma_{Q,i} = 1,50$ where unfavourable (0 where favourable)

NOTE For Ψ values see Table A1.1 (BS).

Table NA.A1.2 (A) – Design values of actions (EQU) (Set A)

Persistent and transient design situations	Permanent actions		Leading variable action[a]	Accompanying variable actions	
	Unfavourable	Favourable		Main (if any)	Others
(Eq. 6.10)	1,10 $G_{kj,sup}$	0,90 $G_{kj,inf}$	1,5 $Q_{k,1}$ (0 when favourable)		1,5$\Psi_{0,i}Q_{k,i}$ (0 when favourable)

[a] Variable actions are those considered in Table NA.A1.1.

In cases where the verification of static equilibrium also involves the resistance of structural members, as an alternative to two separate verifications based on Tables NA.A1.2 (A) and A1.2 (B), a combined verification, based on Table NA.A1.2 (A), should be adopted, with the following set of values.

$\gamma_{Gj,sup} = 1,35$

$\gamma_{Gj,inf} = 1,15$

$\gamma_{Q,1} = 1,50$ where unfavourable (0 where favourable)

$\gamma_{Q,i} = 1,50$ where unfavourable (0 where favourable)

provided that applying $\gamma_{Gj,inf} = 1,00$ both to the favourable part and to the unfavourable part of permanent actions does not give a more unfavourable effect.

NA.2.2.3.2 *Values for the symbols γ and ξ of Table A1.2 (B)*

Table NA.A1.2 (B) provides the values for the symbols γ and ξ of Table A1.2 (B). The values chosen are:

$\gamma_{Gj,sup} = 1,35$

$\gamma_{Gj,inf} = 1,00$

$\gamma_{Q,1} = 1,50$ where unfavourable (0 where favourable)

$\gamma_{Q,i} = 1,50$ where unfavourable (0 where favourable)

$\xi = 0,925$

NOTE For Ψ values see Table NA.A1.1.

Table NA.A1.2 (B) – Design values of actions (STR/GEO) (Set B)

Persistent and transient design situations	Permanent actions		Leading variable action	Accompanying variable actions[a]	
	Unfavourable	Favourable		Main (if any)	Others
(Eq. 6.10)	$1{,}35G_{kj,sup}$	$1{,}00G_{kj,inf}$	$1{,}5Q_{k,1}$		$1{,}5\psi_{0,1}Q_{k,i}$

Persistent and transient design situations	Permanent actions		Leading variable action[a]	Accompanying variable actions[a]	
	Unfavourable	Favourable	Action	Main	Others
(Eq. 6.10a)	$1{,}35G_{kj,sup}$	$1{,}00G_{kj,inf}$		$1{,}5\psi_{0,1}Q_{k,1}$	$1{,}5\psi_{0,1}Q_{k,i}$
(Eq. 6.10b)	$0{,}925*1{,}35G_{kj,sup}$	$1{,}00G_{kj,inf}$	$1{,}5Q_{k,1}$		$1{,}5\psi_{0,1}Q_{k,i}$

NOTE 1 Either expression 6.10, or expression 6.10a together with and 6.10b may be made, as desired.

NOTE 2 The characteristic values of all permanent actions from one source are multiplied by $\gamma_{G,sup}$ if the total resulting action effect is unfavourable and $\gamma_{G,inf}$ if the total resulting action effect is favourable. For example, all actions originating from the self weight of the structure may be considered as coming from one source; this also applies if different materials are involved.

NOTE 3 For particular verifications, the values for γ_G and γ_Q may be subdivided into γ_g and γ_q and the model uncertainty factor γ_{sd}. A value of γ_{sd} in the range 1,05 to 1,15 can be used in most common cases and can be modified in the National Annex.

NOTE 4 When variable actions are favourable Q_k should be taken as 0.

[a] Variable actions are those considered in Table NA.A1.1.

NA.2.2.3.3 *Values for the symbols γ of Table A1.2 (C)*

Table NA.A1.2 (C) provides the values for the symbols γ of Table A1.2 (C). The values chosen are:

$\gamma_{Gj,sup} = 1,00$

$\gamma_{Gj,inf} = 1,00$

$\gamma_{Q,1} = 1,30$ where unfavourable (0 where favourable)

$\gamma_{Q,i} = 1,30$ where unfavourable (0 where favourable)

NOTE For Ψ values see Table NA.A1.1.

Table NA.A1.2 (C) – Design values of actions (STR/GEO) (Set C)

Persistent and transient design situation	Permanent actions		Leading variable action[a]	Accompanying variable actions[a]	
	Unfavourable	Favourable		Main (if any)	Others
(Eq 6.10)	$1,0\ G_{kj,sup}$	$1,0 G_{kj,inf}$	$1,3 Q_{k,1}$ (0 when favourable)		$1,3 \Psi_{0,i} Q_{k,i}$ (0 when favourable)

[a] Variable actions are those considered in Table NA.A1.1.

NA.2.2.4 *Clause A.1.3.1 (5)*

Approach 1 should be used for the design of buildings in the UK.

NA.2.2.5 *Clause A.1.3.2*

Table NA.A1.3 provides the values for the symbols of Table A1.3 of EN 1990. All γ factors are equal to 1,00. Coefficient Ψ_{11} is selected for the main accompanying variable action for the accidental design situation.

NOTE For Ψ values see Table NA.A1.1.

Table NA.A1.3 – Design values of actions for use in accidental and seismic combinations of actions

Design situation	Permanent actions		Leading accidental or seismic action	Accompanying variable actions[b]	
	Unfavourable	Favourable		Main (if any)	Others
Accidental (Eq 6.11a/b)	$G_{kj,sup}$	$G_{kj,inf}$	A_d	$\Psi_{11}\ Q_{k,1}$	$\Psi_{2,i}\ Q_{k,i}$
Seismic[a] (Eq 6.12a/b)	$G_{kj,sup}$	$G_{kj,inf}$	$\gamma_1 A_{Ek}$ or A_{Ed}		$\Psi_{2,i}\ Q_{k,i}$

[a] The seismic design situation should be used only when specified by the client. See also Eurocode 8.
[b] Variable actions are those considered in Table NA.A1.1.

NA.2.2.6 *Clause A1.4.2*

Clause A1.4.2 of EN 1990, states that the serviceability criteria should be specified for each project and agreed with the client. In the absence of specific requirements in EN 1992 to EN 1999 or their National Annexes it is recommended that the following Combination of Action expressions are used with particular serviceability requirements.

- For function and damage to structural and non-structural elements (e.g. partition walls etc.) the characteristic combination (i.e. expression 6.14b of EN 1990).
- For comfort to user, use of machinery, avoiding ponding of water etc. the frequent combination (i.e. expression 6.15b of EN 1990).
- For appearance of the structure the quasi-permanent combination (i.e. expression 6.15c of EN 1990.

Separate consideration should be given to serviceability related to appearance and that related to user comfort which may be affected by structural deformation or vibration.

A1 NA.2.3 Nationally determined parameters for bridges

NA.2.3.1 General [BS EN 1990:2002+A1:2005, A2.1.1(1), Note 3]

See **NA.2.1.1**.

NA.2.3.2 General [BS EN 1990:2002+A1:2005, A2.2.1(2), Note 1]

Combinations involving actions that are outside the scope of BS EN 1991 (all parts) may be determined for the individual project taking account of the general probability of the simultaneous occurrence of different load components following the principles given in BS EN 1990:2002+A1:2005.

NA.2.3.3 Combination rules for road bridges [BS EN 1990:2002+A1:2005, A2.2.2]

NA.2.3.3.1 *A2.2.2(1), Note*

Infrequent combinations of actions need not be used.

NA.2.3.3.2 *A2.2.2(3), Note*

The combination rules for special vehicles with normal traffic are given in NA to BS EN 1991-2:2003. The values of ψ and γ factors given in this National Annex should be used.

NA.2.3.3.3 *A2.2.2(4), Note*

Snow loads may generally be ignored in the UK, see NA to BS EN 1991-1-3. Special cases where snow loads have to be combined with groups gr1a and gr1b in combinations of actions may be determined for the individual project.

NA.2.3.3.4 *A2.2.2(6), Note*

The combination of wind and thermal actions may generally be ignored in the UK. In special cases rules for the combination of wind and thermal actions may be determined for the individual project.

NA.2.3.4 Combination rules for footbridges [BS EN 1990:2002+A1:2005, A2.2.3]

NA.2.3.4.1 *A2.2.3(2), Note*

The combination of wind and thermal actions may generally be ignored in the UK. In special cases rules for the combination of wind and thermal actions may be determined for the individual project.

NA.2.3.4.2 *A2.2.3(3), Note*

Snow loads may generally be ignored in the UK, see NA to BS EN 1991-1-3, except for footbridges that are provided with a roof.

In combinations of loads including snow loads the groups of loads gr1 and gr2 should be applied without reduction of any of the component loads.

Other special cases where snow loads have to be combined with groups gr1 and gr2 in combinations of actions may be determined for the individual project.

NA.2.3.4.3 *A2.2.3(4), Note*

Specific combinations of actions for footbridges on which pedestrian and cycle traffic is fully protected from all types of bad weather may be determined as appropriate for the individual project.

NA.2.3.5 Combination rules for railway bridges [BS EN 1990:2002+A1:2005, A2.2.4]

NA.2.3.5.1 *A2.2.4(1), Note*

Snow loads may generally be ignored in the UK, see NA to BS EN 1991-1-3. Special cases (for example railway bridges with a roof) where snow loads have to be combined with rail traffic in combinations of actions may be determined for the individual project.

NA.2.3.5.2 *A2.2.4(4), Note*

The limit of maximum peak velocity pressure $q_p(z)$, derived from the maximum wind speed that is compatible with rail traffic for determination of F_W**, is given in NA to BS EN 1991-1-4.

NA.2.3.6 Values of ψ factors [BS EN 1990:2002+A1:2005, A2.2.6]

NA.2.3.6.1 *A2.2.6(1), Note 1*

Table NA.A2.1 gives recommended values of ψ factors for road bridges to be used instead of Table A2.1 of BS EN 1990:2002+A1:2005.

Table NA.A2.2 gives recommended values of ψ factors for footbridges to be used instead of Table A2.2 of BS EN 1990:2002+A1:2005.

The recommended values of ψ factors for railway bridges given in Table A2.3 of BS EN 1990:2002+A1:2005 should be used.

NA.2.3.6.2 *A2.2.6(1), Note 2*

The infrequent value of actions defined in BS EN 1990:2002+A1:2005, **4.1.3** Note 2 should not be considered.

NA.2.3.6.3 *A2.2.6(1), Note 3*

Where relevant, representative values of water actions F_{wa} should be determined for the individual project.

Table NA.A2.1 – Recommended values of ψ factors for road bridges

Action	Group of Loads	Load components	ψ_0	ψ_1	ψ_2
Traffic loads	gr1a[a]	TS	0,75	0,75	0
		UDL	0,75	0,75	0
		Footway and cycle-track loads	0,40	0,40	0
	gr1b[a]	Single axle	0	0,75	0
	gr2	Horizontal forces	0	0	0
	gr3	Pedestrian loads	0	0,40	0
	gr4	Crowd loading	0	—[b]	0
	gr5	Vertical forces from SV and SOV vehicles	0	—[b]	0
	gr6	Horizontal forces from SV and SOV vehicles	0	0	0
Wind forces	F_{Wk}	Persistent design situations	0,50	0,20	0
		During execution	0,80	—	0
	F^*_W	During execution	1,0	—	0
Thermal actions	T_k		0,60	0,60	0,50
Snow loads	$Q_{Sn,k}$		0,80	—	—
Construction loads	Q_c		1,0		1,0

[a] The recommended values of ψ_0, ψ_1, ψ_2 for gr1a and gr1b are given for roads with traffic corresponding to adjusting factors α_{Qi}, α_{qi}, α_{qr} and β_Q defined in the NA to BS EN 1991-2:2003.

[b] The frequent values of load groups gr4 and gr5 do not need to be considered in accordance with BS EN 1991-2:2003, **4.5.2.**

NOTE The ψ_0 factors specified for a group of loads apply to all the component actions in that group, except for gr1a where they are individually specified. The ψ_1 and ψ_2 factors always apply to individual components of loading and the values for a given component are the same in all load groups in which the component occurs.

Table NA.A2.2 – Recommended values of ψ factors for footbridges

Action	Symbol	ψ_0	ψ_1	ψ_2
Traffic loads	gr1	0,40	0,40	0
	Q_{fwk}	0	0	0
	gr2	0	0	0
Wind forces	F_{Wk}	0,3	0,2	0
Thermal actions	T_k	0,60	0,60	0,50
Snow loads	$Q_{Sn,k}$ (during execution)	0,80	—	0
Construction loads	Q_c	1,0	—	1,0

NA.2.3.7 Ultimate limit states – Design values of actions in persistent and transient design situations [BS EN 1990:2002+A1:2005, A2.3.1]

NA.2.3.7.1 *A2.3.1(1)*

For the design of bridges the combination of actions should be based on equation 6.10. Table NA.A2.4(A), Table NA.A2.4(B) and Table NA.A2.4(C) give design values of actions for the persistent and transient design situations to be used instead of Tables A2.4(A), Table A2.4(B) and Table A2.4(C) of BS EN 1990:2002+A1:2005.

NA.2.3.7.2 *A2.3.1(5)*

Approach 1 should be used for the design of structural members involving geotechnical actions and the resistance of the ground.

NA.2.3.7.3 *A2.3.1(7)*

Forces due to ice pressure on bridge piers may generally be ignored in the UK. For special cases where it is appropriate to take them into account, the requirements should be determined for the individual project.

NA.2.3.7.4 *A2.3.1(8)*

In the case where γ_P values for prestressing actions are not provided in the relevant design Eurocodes, these values should be determined for the individual project.

Table NA.A2.4(A) – Design values of actions (EQU) (Set A)

Persistent and transient design situation	Permanent actions		Prestress	Leading variable action	Accompanying variable actions	
	Unfavourable	Favourable			Main (if any)	Others
(Eq. 6.10)	$\gamma_{Gj,sup}G_{kj,sup}$	$\gamma_{Gj,inf}G_{kj,inf}$	$\gamma_P P$	$\gamma_{Q,1}Q_{k,1}$		$\gamma_{Q,i}\psi_{0,i}Q_{k,i}$
NOTE 1 For **persistent** design situations the recommended set of values for γ are:						
Permanent actions (contributions from the following components should be combined as appropriate)						
Concrete self weight	$\gamma_{G,sup}$ = 1,05		$\gamma_{G,inf}$ = 0,95			
Steel self weight	$\gamma_{G,sup}$ = 1,05		$\gamma_{G,inf}$ = 0,95			
Super-imposed dead	$\gamma_{G,sup}$ = 1,05		$\gamma_{G,inf}$ = 0,95			
Road surfacing	$\gamma_{G,sup}$ = 1,05		$\gamma_{G,inf}$ = 0,95			
Ballast	$\gamma_{G,sup}$ = 1,05		$\gamma_{G,inf}$ = 0,95			
Weight of soil	$\gamma_{G,sup}$ = 1,05		$\gamma_{G,inf}$ = 0,95			
Self weight of other materials listed in BS EN 1991-1-1:2002, Tables A.1-A.6	$\gamma_{G,sup}$ = 1,05		$\gamma_{G,inf}$ = 0,95			
Prestressing	γ_P as defined in the relevant design Eurocode or for the individual project					
Variable actions						
Road traffic actions (gr1a, gr1b, gr2, gr5, gr6)	γ_Q = 1,35		(0 where favourable)			
Pedestrian actions (gr3, gr4)	γ_Q = 1,35		(0 where favourable)			
Rail traffic actions (LM71, SW/0, HSLM)	γ_Q = 1,45		(0 where favourable)			
Rail traffic actions (SW/2 and other load models representing controlled exceptional traffic)	γ_Q = 1,40		(0 where favourable)			
Rail traffic actions (Real trains)	γ_Q = 1,70		(0 where favourable)			
Wind actions (see Note 5)	γ_Q = 1,70		(0 where favourable)			
Thermal actions (see Note 6)	γ_Q = 1,55		(0 where favourable)			

Table NA.A2.4(A) *(continued)*

NOTE 2 For self-weight of water, ground-water pressure and other actions dependent on the level of water, no partial factor is specified in this National Annex. The design value of such actions may be directly assessed in accordance with **2.4.6.1**(2)P and **2.4.6.1**(6)P of BS EN 1997-1:2004. Alternatively a safety margin may be applied to the characteristic water levelas set out in **2.4.6.1**(8) of BS EN 1997-1:2004. Partial factors for such actions may be determined for the individual project (see **2.4.7.3.2**(2) of BS EN 1997-1:2004).

NOTE 3 The design value of earth pressures should be based on the design value of the actions giving rise to the earth pressure. In some cases supplementary model factors may be required when evaluating horizontal earth pressures (see the National Annex to BS EN 1997-1:2004).

NOTE 4 For all other actions, not covered in NOTES 1 to 3, the partial factors should be determined for the individual project.

NOTE 5 The specified value of γ_Q has been determined for cases where the design working life is 120 years and is used with the characteristic value of wind actions given in BS EN 1991-1-4:2005 which corresponds to a mean return period of 50 years. If the duration of the relevant design situation is taken into account directly using BS EN 1991-1-4:2005, **4.2(2)** a reduced value of $\gamma_Q = 1{,}55$ may be used for unfavourable actions. For persistent design situations, the duration of the design situation may be taken into account by adjusting the wind velocity for a mean return period equal to the design working life but not less than 50 years. For transient design situations, see also BS EN 1991-1-6:2005, **3.1(5)**.

NOTE 6 The specified value of γ_Q has been determined for cases where the design working life is 120 years and is used with the characteristic value of thermal actions given in BS EN 1991-1-5:2003 which corresponds to a mean return period of 50 years. If the duration of the relevant design situation is taken into account directly using BS EN 1991-1-5:2003, **A.2** a reduced value of $\gamma_Q = 1{,}45$ may be used for unfavourable actions. For persistent design situations, the duration of the design situation may be taken into account by adjusting the shade air temperature for a mean return period equal to the design working life but not less than 50 years. For transient design situations, see also BS EN 1991-1-6:2005, **3.1(5)**.

NOTE 7 Partial factors for actions involving the aerodynamic effects of wind on bridges should be determined for the individual project. Guidance on the factors to be considered may be found in PD 6688-1-4.

NOTE 8 The characteristic values of all unfavourable permanent actions are multiplied by $\gamma_{G,sup}$ and the characteristic values of all favourable permanent actions are multiplied by $\gamma_{G,inf}$ irrespective of whether they arise from a single source, see BS EN 1990:2002+A1:2005, **6.4.3.1(4)**. See also BS EN 1990:2002+A1:2005, **A.2.3.1**(2). For design situations involving buried structures, where the stability is highly sensitive to the interaction between the structure and the soil, $\gamma_{G,sup}$ should be applied to unfavourable permanent action effects and $\gamma_{G,inf}$ should be applied to favourable permanent action effects.

NOTE 9 For verification of uplift of bearings of continuous bridges or in cases whether the verification of static equilibrium also involves the resistance of structural elements or the ground γ values may be determined for the individual project as an alternative to separate verifications based on Tables NA.A2.4(A)-(C), see also BS EN 1990:2002+A1:2005, **6.4.3.1(4)**.

NOTE 10 For *transient* design situations, during which there is a loss of static equilibrium, $Q_{k,1}$ represents the dominant destabilising variable action and $Q_{k,i}$ represents the relevant accompanying destabilising variable actions.

During execution, if the construction process is adequately controlled, the recommended set of values for γ for the persistent design situations given above may be used with the exceptions set out below:

(A) Where a counterweight is used, the variability of its characteristics may be taken into account, for example, by one or both of the following rules:
- applying a partial factor $\gamma_{G,\mathrm{inf}} = 0{,}8$ where the self weight is not well defined (e.g. containers);
- by considering a variation of its project-defined location, with a value to be specified proportionately to the dimensions of the bridge, where the magnitude of the counterweight is well defined. For steel bridges during launching, the variation of the counterweight location is often taken equal to ±1 m.

(B) Where loss of equilibrium could result in multiple fatalities (for example bridges constructed over railways or motorways), partial factors for permanent actions affecting stability ($\gamma_{G,sup}$ and $\gamma_{G,\mathrm{inf}}$), should be increased to 1,15 and decreased to 0,85 respectively.

Table NA.A2.4(B) – Design values of actions (STR/GEO) (Set B)

Persistent and transient design situation	Permanent actions		Prestress	Leading variable action	Accompanying variable actions	
	Unfavourable	Favourable			Main	Others
(Eq. 6.10)	$\gamma_{Gj,\sup}G_{kj,\sup}$	$\gamma_{Gj,\inf}G_{kj,\inf}$	$\gamma_P P$	$\gamma_{Q,1}Q_{k,1}$		$\gamma_{Q,i}\psi_{0,i}Q_{k,i}$

NOTE 1 For **persistent** design situations the recommended set of values for γ are:

Permanent Actions (contributions from the following components should be combined as appropriate)

Concrete self weight	$\gamma_{G,sup}$ = 1,35	$\gamma_{G,inf}$ = 0,95
Steel self weight	$\gamma_{G,sup}$ = 1,20	$\gamma_{G,inf}$ = 0,95
Super-imposed dead	$\gamma_{G,sup}$ = 1,20	$\gamma_{G,inf}$ = 0,95
Road surfacing	$\gamma_{G,sup}$ = 1,20	$\gamma_{G,inf}$ = 0,95
Ballast	$\gamma_{G,sup}$ = 1,35	$\gamma_{G,inf}$ = 0,95
Weight of soil	$\gamma_{G,sup}$ = 1,35	$\gamma_{G,inf}$ = 0,95
Self weight of other materials listed in BS EN 1991-1-1:2002 Tables A.1–A.6	$\gamma_{G,sup}$ = 1,35	$\gamma_{G,inf}$ = 0,95
Settlement (linear structural analysis)	$\gamma_{G,set\ sup}$ = 1,20	$\gamma_{G,set,inf}$ = 0,00
Settlement (nonlinear structural analysis)	$\gamma_{G,set,sup}$ = 1,35	$\gamma_{Gset,,inf}$ = 0,00
Prestressing	γ_P as defined in the relevant design Eurocode or for the individual project	

Variable actions

Road traffic actions (gr1a, gr1b, gr2, gr5, gr6)	γ_Q = 1,35	(0 where favourable)
Pedestrian actions (gr3, gr4)	γ_Q = 1,35	(0 where favourable)
Rail traffic actions (LM71, SW/0, HSLM)	γ_Q = 1,45	(0 where favourable)
Rail traffic actions (SW/2 and other load models representing controlled exceptional traffic)	γ_Q = 1,40	(0 where favourable)
Rail traffic actions (Real trains)	γ_Q = 1,70	(0 where favourable)
Wind actions (see Note 5)	γ_Q = 1,70	(0 where favourable)
Thermal actions (see Note 6)	γ_Q = 1,55	(0 where favourable)

NOTE 2 For self-weight of water, ground-water pressure and other actions dependent on the level of water, no partial factor is specified in this National Annex. The design value of such actions may be directly assessed in accordance with **2.4.6.1**(2)P and **2.4.6.1**(6)P of BS EN 1997-1:2004. Alternatively a safety margin may be applied to the characteristic water level (see **2.4.6.1**(8) of BS EN 1997-1:2004). Partial factors for such actions may be determined for the individual project, but see **2.4.7.3.2**(2) of BS EN 1997-1:2004.

NOTE 3 The design value of earth pressures should be based on the design value of the actions giving rise to the earth pressure. In some cases supplementary model factors may be required when evaluating horizontal earth pressures (see NA to BS EN 1997-1:2004).

NOTE 4 For all other actions, not covered in NOTES 1 to 3, the partial factors should be determined for the individual project.

NOTE 5 The specified value of γ_Q has been determined for cases where the design working life is 120 years and is used with the characteristic value of wind actions given in BS EN 1991-1-4:2005 which corresponds to a mean return period of 50 years. If the duration of the relevant design situation is taken into account directly using BS EN 1991-1-4:2005, **4.2(2)** a reduced value of γ_Q = 1,55 may be used for unfavourable actions. For persistent design situations, the duration of the design situation may be taken into account by adjusting the wind velocity for a mean return period equal to the design working life but not less than 50 years. For transient design situations, see also BS EN 1991-1-6:2005, **3.1(5)**.

NOTE 6 The specified value of γ_Q has been determined for cases where the design working life is 120 years and is used with the characteristic value of thermal actions given in BS EN 1991-1-5:2003 which corresponds to a mean return period of 50 years. If the duration of the relevant design situation is taken into account directly using BS EN 1991-1-5:2005, **A.2** a reduced value of γ_Q = 1,45 may be used for unfavourable actions. For persistent design situations, the duration of the design situation may be taken into account by adjusting the shade air temperature for a mean return period equal to the design working life but not less than 50 years. For transient design situations, see also BS EN 1991-1-6:2005, **3.1(5)**.

NOTE 7 Partial factors for actions involving the aerodynamic effects of wind on bridges should be determined for the individual project. Guidance on the factors to be considered may be found in PD 6688-1-4.

NOTE 8 The characteristic values of all permanent actions from one source may be multiplied by $\gamma_{G,sup}$ if the total resulting action effect from this source is unfavourable, and by $\gamma_{G,inf}$ if the total resulting action effect from this source is favourable. However, where a verification is very sensitive to variations in the magnitude of a permanent action from place to place and also involves the resistance of structural elements or the ground, see Table NA.A2.4(A) Note 9. See also BS EN 1990:2002+A1:2005 **6.4.3.1(4)** and **A2.3.1**(2).

NOTE 9 For particular verifications, the values of γ_G and γ_Q may be sub-divided into γ_g and γ_q and the model uncertainty factor γ_{Sd}. A value of γ_{Sd} = 1,15 can be used except where otherwise determined for the individual project.

Table NA.A2.4(C) – Design values of actions (STR/GEO) (Set C)

Persistent and transient design situation	Permanent actions		Prestress	Leading variable action	Accompanying variable actions	
	Unfavourable	Favourable			Main (if any)	Others
(Eq. 6.10)	$\gamma_{Gj,\sup} G_{kj,\sup}$	$\gamma_{Gj,\inf} G_{kj,\inf}$	$\gamma_P P$	$\gamma_{Q,1} Q_{k,1}$		$\gamma_{Q,i} \psi_{0,i} Q_{k,i}$

NOTE 1 For *persistent* design situations the recommended set of values for γ are:

Permanent actions (contributions from the following components should be combined as appropriate)		
Concrete self weight	$\gamma_{G,sup}$ = 1,00	$\gamma_{G,inf}$ = 1.00
Steel self weight	$\gamma_{G,sup}$ = 1,00	$\gamma_{G,inf}$ = 1.00
Super-imposed dead	$\gamma_{G,sup}$ = 1,00	$\gamma_{G,inf}$ = 1.00
Road surfacing	$\gamma_{G,sup}$ = 1,00	$\gamma_{G,inf}$ = 1.00
Ballast	$\gamma_{G,sup}$ = 1,00	$\gamma_{G,inf}$ = 1.00
Weight of soil	$\gamma_{G,sup}$ = 1,00	$\gamma_{G,inf}$ = 1.00
Self weight of other materials listed in BS EN 1991-1-1:2002, Tables A.1—A.6	$\gamma_{G,sup}$ = 1,00	$\gamma_{G,inf}$ = 1.00
Settlement (linear structural analysis)	$\gamma_{G,set\ sup}$ = 1,00	$\gamma_{G,set,inf}$ = 0,00
Settlement (nonlinear structural analysis)	$\gamma_{G,set\ sup}$ = 1,00	$\gamma_{G,set,inf}$ = 0,00
Prestressing	γ_P as defined in the relevant design Eurocode or for the individual project	
Variable actions		
Road traffic actions	γ_Q = 1,15	(0 where favourable)
(gr1a, gr1b, gr2, gr5, gr6)		
Pedestrian actions (gr3, gr4)	γ_Q = 1,15	(0 where favourable)
Rail traffic actions (LM71, SW/0,	γ_Q = 1,25	(0 where favourable)
HSLM)		
Rail traffic actions (SW/2and other load models representing controlled exceptional traffic)	γ_Q = 1,20	(0 where favourable)
Rail traffic actions (Real trains)	γ_Q = 1,45	(0 where favourable)
Wind actions (see Note 5)	γ_Q = 1,45	(0 where favourable)
Thermal actions (see Note 6)	γ_Q = 1,30	(0 where favourable)

NOTE 2 For self-weight of water, ground-water pressure and other actions dependent on the level of water, no partial factor is specified in this National annex. The design value of such actions may be directly assessed in accordance with **2.4.6.1**(2)P and **2.4.6.1**(6)P of BS EN 1997-1:2004. Alternatively a safety margin may be applied to the characteristic water level (see **2.4.6.1**(8) of BS EN 1997-1:2004). Partial factors for such actions may be determined for the individual project and agreed with the relevant authority, but see **2.4.7.3.2**(2) of BS EN 1997-1:2004.

NOTE 3 The design value of earth pressures should be based on the design value of the actions giving rise to the earth pressure. In some cases supplementary model factors may be required when evaluating horizontal earth pressures, see NA to BS EN 1997-1:2004.

NOTE 4 For all other actions, not covered in NOTES 1 to 3, the partial factors should be determined for the individual project.

NOTE 5 The specified value of γ_Q has been determined for cases where the design working life is 120 years and is used with the characteristic value of wind actions given in BS EN 1991-1-4:2005 which corresponds to a mean return period of 50 years. If the duration of the relevant design situation is taken into account directly using BS EN 1991-1-4:2005, **4.2(2)** a reduced value of γ_Q = 1,30 may be used for unfavourable actions. For persistent design situations, the duration of the design situation may be taken into account by adjusting the wind velocity for a mean return period equal to the design working life but not less than 50 years. For transient design situations, see also BS EN 1991-1-6:2005, **3.1(5)**.

NOTE 6 The specified value of γ_Q has been determined for cases where the design working life is 120 years and is used with the characteristic value of thermal actions given in BS EN 1991-1-5:2003 which corresponds to a mean return period of 50 years. If the duration of the relevant design situation is taken into account directly using BS EN 1991-1-5:2003, **A.2** a reduced value of γ_Q = 1,20 may be used for unfavourable actions. For persistent design situations, the duration of the design situation may be taken into account by adjusting the shade air temperature for a mean return period equal to the design working life but not less than 50 years. For transient design situations, see also BS EN 1991-1-6:2005, **3.1(5)**.

NOTE 7 Partial factors for actions involving the aerodynamic effects of wind on bridges should be determined for the individual project. Guidance on the factors to be considered may be found in PD 6688-1-4.

NOTE 8 The characteristic values of all permanent actions from one source may be multiplied by $\gamma_{G,sup}$ if the total resulting action effect from this source is unfavourable, and by $\gamma_{G,inf}$ if the total resulting action from this source is favourable. However, where a verification is very sensitive to variations in the magnitude of a permanent action from place to place and also involves the resistance of structural elements or the ground, see Table NA.A2.4(A) Note 9. See also BS EN 1990:2002+A1:2005, **6.4.3.1(4)** and **A2.3.1(2).**

NOTE 9 For particular verifications, the values of γ_Q may be sub-divided into γ_q and the model uncertainty factorγ_{Sd}. A value for γ_{Sd} between 1,05 and 1,15, should be determined for the individual project.

NA.2.3.8 Design values of actions in the accidental and seismic design situations [BS EN 1990:2002+A1:2005, A2.3.2(1), Table A2.5]

All the partial factors γ should be taken equal to 1.0 in using the design values of actions given in Table NA.A.2.5. The values of ψ factors should be taken from Table NA.A2.1, Table NA.A2.2, or Table A.2.3 of BS EN 1990:2002+A1:2005 as appropriate.

Table NA.A2.5 – Design values of actions for use in accidental and seismic combinations of actions

Design situation	Permanent actions		Prestress	Accidental or seismic action	Accompanying variable actions	
	Unfavourable	Favourable			Main (if any)	Others
Accidental[A] (BS EN 1990(A1):2005, Eq. 6.11a/b)	$G_{kj,sup}$	$G_{kj,inf}$	P	A_d	$\psi_{1,1}Q_{k,1}$	$\psi_{2,i}\ Q_{k,i}$
Seismic[B] (BS EN 1990(A1):2005, Eq. 6.12a/b)	$G_{kj,sup}$	$G_{kj,inf}$	P	$A_{Ed} = \gamma_I A_{Ek}$	$\psi_{2,i}\ Q_{k,i}$	

[A] In the case of accidental design situations, the main variable action may be taken with its frequent value with the combination factor ψ_1 given in Table NA.A2.1, Table NA.A2.2, or Table A2.3 as appropriate.
[B] The seismic design situation should be used only when specified for the individual project (see BS EN 1998).

NA.2.3.9 Serviceability and other specific limit states – General [BS EN 1990:2002+A1:2005, A2.4.1]

NA.2.3.9.1 *A2.4.1(1) Note 1*

All the partial factors γ should be taken equal to 1.0 and the design values of actions given in Table A2.6 of BS EN 1990:2002+A1:2005 for serviceability limit state should be used.

NA.2.3.9.2 *A2.4.1(1) Note 2*

The infrequent value of actions defined in BS EN 1990:2002+A1:2005, **4.1.3** Note 2 need not be considered.

NA 2.3.9.3 *A2.4.1(2) Note*

Serviceability requirements and criteria may be determined as appropriate for the individual project.

NA.2.3.10 Pedestrian comfort criteria (for serviceability) [BS EN 1990:2002+A1:2005, A2.4.3.2(1)]

The pedestrian comfort criteria should be as given in **NA.2.44** of NA to BS EN 1991-2:2003.

NA.2.3.11 Verifications regarding deformations and vibrations for railway bridges [BS EN 1990:2002+A1:2005, A2.4.4]

NA.2.3.11.1 *A2.4.4.1(1) Note 3 – General*

Limits of deformation and vibration (frequency and acceleration) for temporary bridges should be determined for the individual project.

NA.2.3.11.2 *A2.4.4.2.1(4) Note – Criteria for traffic safety – Vertical acceleration of the deck*

The maximum peak values of bridge deck acceleration and the associated frequency limits should be determined for the individual project.

NA.2.3.11.3 *A2.4.4.2.2(2) Note – Criteria for traffic safety – Deck twist*

The values of maximum twist (t) for track of any gauge should be determined for the individual project.

NA.2.3.11.4 *A2.4.4.2.2(3) Note – Criteria for traffic safety – Deck twist*

The recommended value for total track twist (t_T) should be used.

NA.2.3.11.5 *A2.4.4.2.3(1) Note – Criteria for traffic safety – Vertical deformation of the deck*

Additional requirements for limiting vertical deformation for ballasted and non-ballasted bridges may be determined for the individual project.

NA.2.3.11.6 *A2.4.4.2.3(2) Note – Criteria for traffic safety – Vertical deformation of the deck*

The limit of rotation at the ends of non-ballasted bridge decks should be determined for the individual project.

NA.2.3.11.7 *A2.4.4.2.3(3) Note – Criteria for traffic safety – Vertical deformation of the deck*

Additional limits for angular rotation at the ends of bridge decks in the vicinity of expansion devices and switches and crossings, may be specified for the individual project.

NA.2.3.11.8 *A2.4.4.2.4(2) Note – Criteria for traffic safety – Transverse deflection of the deck*

The maximum differential transverse deflection at the top of the deck should be compatible with the limits for maximum horizontal rotation and maximum change of radius of curvature, set out in BS EN 1990:2002+A1:2005, Table A2.8.

NA.2.3.11.9 *A2.4.4.2.4(2) Table A2.8 NOTE 3 – Maximum horizontal rotation and maximum change of radius of curvature*

The recommended values should be used.

NA.2.3.11.10 *A2.4.4.2.4(3) Note – First natural frequency of lateral vibration*

The value for the first natural frequency of lateral vibration should be determined for the individual project.

NA.2.3.11.10 *A2.4.4.3.2(6) Note – Limiting values for the maximum vertical deflection for passenger comfort – Deflection criteria for checking passenger comfort*

The requirements for passenger comfort should be determined for the individual project. A1

NA.3 Guidance on using the informative annexes B, C and D

NA.3.1 For buildings

NA.3.1.1 *Annex B*

Annex B may be used. If used it should be in accordance with the full reliability based approach described in Annex C of EN 1990.

Annex B provides informative guidance relating to a number of the assumptions (see Clause 1.3 of EN 1990), and in particular on quality management and control measures in design, detailing and execution which aim to eliminate failures due to gross errors, and to achieve the resistance assumed in the design.

For this purpose the use of Clauses B4 and B5 of this Annex are recommended.

NA.3.1.2 *Annex C*

Annex C may be used for calibration purposes, and for cases of actions not covered by EN 1991.

NA.3.1.3 *Annex D*

Annex D may be used.

A1 NOTE Guidance on using Annexes B, C and D for cranes and machinery, silos and tanks, towers and masts, etc. will be given when available. A1

A1 NA.3.2 For bridges

NA.3.2.1 *Annex B*

Annex B may be used where appropriate subject to the following modifications.

With reference to **B3** of Annex B, bridges should normally be treated as medium consequence structures (consequence class 2). Design for a lower or higher consequence class may be considered for an individual project.

In the absence of a project-specific requirement, the minimum values for reliability index given in Table B2 may be used where a probabilistic design approach is adopted (see **NA.3.2.2** of this National Annex).

NA.3.2.2 *Annex C*

With regard to **3.5**(5) of BS EN 1990:2002+A1:2005, a design based on probabilistic methods may be considered for an individual project. Where a probabilistic approach is adopted, Annex C may be used where appropriate and subject to the following modification:

C7 of Annex C should only be used to derive design values for cases not explicitly covered by this National Annex.

NA.3.2.3 *Annex D*

Annex D may be used where appropriate. A1

NA.4 Reference to non-contradictory complementary information (NCCI) and Bibliography

NA.4.1 For buildings

None.

A1 NOTE References to any non-contradictory complementary information for cranes and machinery, silos and tanks, towers and masts, etc. will be given when available.

NA.4.2 For bridges

PD 6704, *Guidance on the design of structures to the UK National Annex to BS EN 1990*[1)]

PD 6688-1-4, *Background information to the UK National Annex to BS EN 1991-1-4 and additional guidance*[1)]

PD 6698, *Recommendations for the design of structures for earthquake resistance to BS EN 1998*[1)]

Bibliography

BS EN 1991 (all parts), *Eurocode 1 – Actions on structures*

BS EN 1997-1:2004, *Eurocode 7 – Geotechnical design – Part 1: General rules*

NA to BS EN 1991-1-1:2002, *UK National Annex to Eurocode 1 – Actions on structures – Part 1-1: General actions – Densities, self-weight, imposed loads for buildings*

NA to BS EN 1991-1-3, *UK National Annex to Eurocode 1 – Actions on structures – Part 1-3: General actions – Snow loads*

NA to BS EN 1991-1-4:2005, *UK National Annex to Eurocode 1 – Actions on structures – Part 1-4: General actions – Wind actions*

NA to BS EN 1991-1-5:2003, *UK National Annex to Eurocode 1 – Actions on structures – Part 1-5: General actions – Thermal actions*

NA to BS EN 1991-1-6:2005, *UK National Annex to Eurocode 1 – Actions on structures – Part 1-6: General actions – Actions during execution*

NA to BS EN 1991-2:2003, *UK National Annex to Eurocode 1 – Actions on structures – Part 2: Traffic loads on bridges*

NA to BS EN 1997-1:2004, *UK National Annex to Eurocode 7 – Geotechnical design – Part 1: General rules* A1

[1)] In preparation.

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